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An analysis of mobile Internet service in Thailand:

Implications for bridging digital divide

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Abstract

Mobile Internet is growing around the world without exception for developing countries like Thailand by passing the poor legacy wired infrastructure. This study attempts to provide guidance to a national regulatory agency (NRA) by addressing the following question: What are the key determining factors to explain the probability that individual consumer will use mobile Internet? The discrete choice model is employed to empirically examine whether the service and application attributes, socio-economic variables and service provider has systematic link with the decision of consumer. The data from a national survey in 2010 commissioned by the National Telecommunications Commission (NTC) of Thailand is used for the analysis. Based on the findings, fixed telephony, e-mail, age, area of living and mobile operator are recognized as the strongest determinants for mobile Internet adoption. The findings suggest that the mobile Internet becomes an alternative technology to bridge the digital divide since a group of people who have no fixed Internet connection at home they can connect the Internet via mobile Internet. As such, telecom regulator and policy makers need to consider the policies regarding to infrastructure investment frequency allocation, content and application development and competition in order to stimulate the growth of mobile Internet adoption and close the digital divide within country.

Keywords: Mobile Internet, digital divide, developing country

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An analysis of mobile Internet service in Thailand: Implications for bridging digital divide

1. Introduction

With the growing penetration of wireless devices and the rapid technological innovation, wireless technology shifts the world of wired Internet to wireless mobile Internet. Mobile Internet, which is generally defined as the use of the Internet via hand-held devices such as mobile phones, smartphone, personal digital assistants (PDAs) and laptop, is considered to be significantly different from the fixed Internet at least in term of time and place flexibility. Mobile Internet provides is not only voice communication but also data and video information at Internet speeds through mobile devices, for example money transfer, location-based services, mobile search, mobile browsing, mobile health monitoring and mobile payment. This leads to an astonishing growth rate of mobile Internet worldwide.

Evidently, mobile Internet has driven fundamental changes in the mobile industry, business, individual lifestyles and society at large. By 2013, mobile phones will overtake personal computers (PCs) as the most common web access device worldwide. The combined installed base of smartphones and browser-equipped enhanced phones will exceed 1.82 billion units and will be greater than the installed base for PCs which is expected that 1.78 billion units (Gartner, 2010). This presents the increasing consumer interest in mobile Internet and the new source of revenue for industry players.

Moreover, the benefits of mobile Internet can be seen also as another alternative for bridging digital divide, in particular for developing country. Digital divide is well-documented in the tendency to connect to the Internet in previous studies e.g. Hoffman and Novak (2000), Fox, (2005) and Chinn and Fairlie (2007). Developing countries face with this digital disparity due to the under developed fixed-line network which leads to higher price of fixed Internet service. On the other hand, there was apparently a leap-frogging of mobile over fixed both in term of infrastructure and subscription in developing countries. This could provide an opportunity for the citizen in that particular country to access to the Internet. Gunasekaran and Harmantzis (2007) noted that three main issues must be considered in order to bridge the digital divide in developing country: accessibility, availability and affordability of service and application. Many technologies have been failed to address these key challenges, but wireless technology has the potential to address all of them.

Among the developing countries, Thailand is also the one which confronts with the digital divide both within country and international (Tangkitvanitch, 2005 and Srinuan et al., 2010). The mobile penetration rate in Thailand surpassed fixed telephony since 2002. At the end of 2009, the mobile penetration rate is 102.02% while the fixed telephony and Internet penetration rate is 11.12% and 25.80% (NTC, 2010). The

gap between Internet and fixed telephony penetration rate indicates that there are some group of Internet user access and use Internet via other technologies, for example mobile Internet. The two trends which have been driving the growth of mobile Internet are the introduction of third generation mobile technology (3G), which is still yet to be fully available in the country, and the availability of better data coverage of mobile infrastructure.

Despite delay in the issue 3G licenses and deployment of infrastructure in Thailand, it is expected that the wireless telecommunications will migrate from 2.5G based mobile systems, which are designed to support more data centric further to 3G-based systems or beyond which is allowing for multimedia transmission. Since this convergence offer great potential for increasing Internet penetration rates and include the non-Internet user in the near future, it is argued that valuable insight from the current usage of mobile Internet can be gathered to inform and guide the national regulatory agency (NRA) and policy maker regarding the digital divide.

With this aim, this study conducts an analysis of the mobile Internet service in Thailand based upon a survey sample of individual user, using data commissioned by the National Telecommunications commission (NTC), Thai telecom regulator, in 2010. The main research questions are to examine the determinant factors for mobile Internet usage in Thailand. An overview of an overview of mobile Internet in Thailand and a brief discussion of the relevant academic studies are provided in the next section. In section 3, the data and econometric method is introduced. Section 4 presents the findings and discusses policy implications of the results. Finally, this study ends with the conclusion in Section 6.

2. Related literature

a. An overview of mobile Internet service in Thailand

Mobile communications services have been introduced in Thailand more than two decades. The mobile subscriber has gradually increased year by year and the mobile penetration rate reached 100% in 2010. At the same time, the mobile Internet user is also growing. According to NTC (2010), there are 30% of mobile subscribers using mobile Internet. This may suggest that mobile Internet will become a common mean to access to the Internet in Thailand where the fixed Internet infrastructure is far from well developed (see Table1).

Table 1 Mobile subscribers, penetration, mobile data, and mobile per fixed subscribers

	2003	2004	2005	2006	2007	2008	2009	2010
Subscribers (millions)	21.62	26.97	30.46	40.13	52.97	61.84	65.95	69.68
Penetration rate (%)	33.79	41.79	46.79	61.19	80.21	93.01	98.58	104.16
Mobile Internet per total subscriber	N/A	N/A	23.58	21.30	19.28	24.70	28.93	30.30
Household fixedline penetration	36.06	34.42	36.10	38.07	39.46	39.17	38.65	37.83

Source: NTC (2010)

The first mobile Internet was introduced in December 2000 by AIS, the largest nationwide mobile operator. AIS launched WAP (Wireless Application Protocol) service so-called *'mobileLIFE'* to its customers. At the initial period, mobileLIFE offered limited contents on this portal e.g. headline news and video on demand, traffic reports, and messaging (AIS, 2003). AIS has developed this application continuously. In 2007, AIS introduce the newest version of mobileLIFE which gives an easy access to various mobile websites including mobile chat, news, music, games, movies, and Google mobile (AIS, 2007). AIS claimed that mobileLIFE helping it to attract users to mobile Internet.

Figure 1 mobileLIFE portal on Smart phone

Source: AIS annual report 2007

DTAC, the second largest mobile operator, launched a mobile Internet portal, *'Djuice'*[1], in September 2001 by using also WAP technology. Djuice contents are similar to mobileLIFE of AIS. The contents include live stock quotes, news, sports, entertainment, and third party e-mail services (DTAC, 2001). This mobile internet portal was alive for a number of years and it has gone from the market and DTAC's focus. The discontinuity of this service might result from Djuice is not developed by Thai provider and its contents may not fit with Thai consumer preference.

[1] Djuice is a mobile Internet portal developed by Telenor and adapted with DTAC for the Thai market

'Orange World' was introduced as the multimedia service portal in 2004 (True, 2004). TA Orange (former name of TrueMove) started to launch a set of contents in Orange World including Photo World, Financial World, Game World, and Toon World. Customers of TA Orange could access to this mobile Internet portal via GPRS (General Packet Radio Service) technology which is a newer and higher capacity of Internet connection. Currently, this mobile Internet portal remains under the name of *'trueworld'* due to the company has renamed to be TrueMove since 2006.

Mobile operators in Thailand did not only develop and adapt the mobile Internet portal and at the same time they also improve their speed of mobile Internet connection during the last decade. DTAC is the first mobile operator who implemented GPRS technology on its own nationwide network in 2001. It is also the first operator of improving its network by introducing EDGE (Enhanced Data rates for Global Evolution) technology in 2004. Other two major mobile Internet providers, AIS and TrueMove, implemented GPRS in 2001 and 2004 respectively. Later, both AIS and True move launched EDGE in 2007.

The gradually improvement of mobile network helps the data transmission rate of mobile Internet to exceed the traditional dial-up connection. Mobile Internet user could access to the Internet at 100 kbps and 150 kbps on average for AIS and DTAC customers. This speed is about 2 – 3 times of dial-up speed of connection. Mobile operators start to run limited trials of 3G networks in the 850 MHz (for TrueMove and DTAC) and 900 MHz band (for AIS) and implement heavily campaign on bundle packages which include low price of Smartphone and Internet package with 3G service. AIS and TrueMove design their bundle package which combine Wi-Fi and other telecom services to provide the convenient way to access to Internet and get single bill payment. This indicates that all operators are preparing move forward to 3G technology.

Table 2 Comparison of major mobile Internet in Thailand

Characteristics	AIS	DTAC	TrueMove
Mobile subscribers	30 425 700	20 935 813	16 537 382
Market share at 2010 (by subscribers)	43,66	30,04	23,73
Year of entry	1990	1991	2002
Concession end	2016	2018	2018
Number of base station	15 400	10 082	N/A
Populated converage (%)	97	N/A	N/A
Mobile Internet application and year of launch	mobileLIFE (2000)	Djuice(2001)	trueworld (2004)
Mobile Internet technology	WAP(2000)/ GPRS(2002)/ EDGE(2007)	WAP(2001)/ GPRS(2001)/ EDGE(2004)	GPRS(2004)/ EDGE(2007)
Speed (average)	100 kbps	150 - 160 kps	N/A
Bundle package with other telecom services	Yes (2007)	N/A	Yes (2004)

Characteristics	AIS	DTAC	TrueMove
	with Wi-Fi		with Wi-Fi /TV/broadband/ fixed telephone
Introduce Internet SIM	2008	2008	2008

Note:N/A refers to not available.

Source: company websites and compiled by authors

On the regulator side, NTC- the Thai telecom regulator has been trying to award 3G licenses for the past couple of years, but the political situation combined with the legal challenge has made it difficult. The Supreme Administrative Court has instructed the NTC does not have authority to issue the 3G licence. There is a need to form the National Broadcasting and Telecommunications Commission (NBTC) or a new regulatory body to oversee the matter due to the 2007constitution (Bangkok Post, 2010). The delay may hamper the network deployment of mobile operator and impede the growth of mobile Internet adoption.

b. Prior studies

The earlier studies on mobile Internet can be divided into two groups based on their method and implication. The first one is mainly focus on the Technology Acceptance Model (TAM) in order to give the implication for business while the second one is primarily use either the diffusion model or econometric model to analyze the behavior of mobile Internet user and provide the suggestion to the policy makers. In order to examine the determinant factors of mobile Internet usage, a brief review of the relevant studies will be discussed in this section.

The study by Cheong and Park (2005) is the one among of the earlier studies on the mobile Internet by using TAM. They find that the attitude toward mobile Internet is the most significant factor in predicting the intention behavior. Also, the perceived playfulness has a positive role in developing the attitude as well as the intention while the perceived price level shows a negative role. Later studies by Hong et al. (2006), Shin (2007) and Phuangthong and Malisuwan (2008) confirm the finding from the previous studies, in particular the study by Phuangthong and Malisuwan which provide the empirical results on the case of Thailand. Additionally, the study by Funk (2005) and Okazaki (2006) give more details on the individual behavior in Japan. Funk (2005) reveals that push mail service and micro-payment system are the key drivers of mobile Internet growth. In term of user adoption, affluent youth is the core segment in mobile Internet adoption (Okazaki, 2006)

Apart from the understanding the user acceptance on mobile Internet, there are very few studies that provide insight about the behavior comparing of mobile Internet user and non user. Most of them discuss

the gap between Internet users and nonusers via fixed Internet (including fixed broadband). For example, Madden et al. (1966) show that income, installation fee and age are factors determining the Internet usage. Rice and Katz (2003), Rappoport et al. (2003) and Cerno and Pérez Amaral (2006) also confirm that income and age are significant factors to explain the gap between Internet users and nonusers. In addition, the last two studies find that level of education also can explain the behavior of Internet user.

Currently, some mobile handsets allow connections not only via 3G technologies but via Wi-Fi and Bluetooth radio interface as well. A number of studies have been conducted to investigate the adoption process of both mobile Internet user and non user and contribute their results to the policy makers. Wareham et al. (2004) suggest that the non-Internet user among American household have adopted 2G mobile communication devices at rates equal or faster than the base population. As such, a migration path from 2G devices to mobile Internet may be the most reasonable way to Internet connectivity for nonusers. Ishii (2004) also gives an example of Japanese market and his results demonstrate that mobile Internet is a more time enhancing activity while PC Internet is more time displacing activity. Service application is another factor that influences the adoption of mobile Internet. The results of Hsu et al. (2007) indicate that users in Taiwan are usually concern about the usefulness of Multimedia message service (MMS) is another key element in motivating the majority of adopters and potential adopters. Recently, Cardona et al. (2009) present a certain acceptance of mobile broadband as further access alternative in Austrian market. Specifically, there appears to be some potential for substitution with regard to private users while business users are more likely to continue their complementary use of both fixed and mobile broadband.

These previous studies show that the mobile Internet becomes another alternative for consumer to access to the Internet both in developed and developing countries. The significant factors for mobile Internet adoption are the consumers' attitudes towards, service applications and the socio-economic backgrounds. This study, however, also considers the important of fixed telephony as a basic connection for Internet. The case studies from many countries show that one of hindrance in Internet readiness between countries or difference part of country is the lack or under developed fixed infrastructure (Frieden, 2005 and Lai and Brewer, 2006). The fixed line facilities may reveal a country's technological development. In term of the voice communication, it can reflect consumer's decision of using between fixed and mobile telephony (Ahn and Lee, 1999). It can also determining the mobile Internet adoption in a country which is underdeveloped fixed infrastructure.

Moreover, there is less research focus on the mobile Internet adoption in developing countries, which confront with the lack of fixed infrastructure at the same time these countries have high mobile penetration rates, and discuss the possible role of mobile Internet for closing the digital divide. This study

aims to fill in this gap by taking a nationwide survey data of individual focusing on the behavior of mobile Internet users in order to identify pulling forced driving the use and the adoption of mobile Internet.

3. Data and method

a. Data

A nationwide face to face interview based survey of people in Thailand was commissioned by the National Telecommunication Communications (NTC) in 2010 and this survey was administered by Thammasat University during May and June in the same year. The questionnaire consists ten parts. Nine of them ask about the telecommunication and media services for example fixed telephony, mobile telephony, Internet, public phone, radio and television and the rest is the socio-economic backgrounds.

The respondents are collected across each region of Thailand: Bangkok, Central, North, Northeast and South. By the end of June, 2000 completed questionnaires were obtained, giving an effective response rate of 90.87%. However, the sample consists of two groups of respondent which are mobile Internet user which means who connecting Internet via the mobile device and USB cards and non-mobile Internet user due to the aim of this study. All respondent were aged below 15 years and incompleted answers related to this study were excluded from the sample. The final complete sample is then 1013 respondents after data cleaning as shown in Table 3.

Table 3 Socio-economic backgrounds

(a) Gender

	Male	Female
%	49.46	50.54

(b) Ages

	15 - 19	20 - 29	30 - 39	40 - 49	50 - 59	60 - 69
%	17.34	40.84	23.80	9.89	4.51	3.62

(c) Education

	Below undergrad	Undergrad	Above undergrad
%	37.22	51.62	11.17

(d) Monthly income (THB)

	< 5000	5001 - 10000	10001 - 15000	15001 - 20000	20001 - 25000	> 25000
%	24.98	33.40	16.55	12.34	3.43	9.30

Among this sample, 11.17% is the mobile Internet users and 88.83% of the respondents are non-mobile Internet user as shown in Table 4. The non-mobile Internet users are the combination of the respondents who use fixed Internet and non–Internet users.

Table 4 Using and non using mobile Internet

	%
Non- mobile Internet user	88.83
Mobile Internet user	11.17

In term of gender, more than 80% of male and female are non –mobile Internet users. Though, female (11.63%) become a mobile Internet user higher than male (10.69%) but the different is not obvious as shown Table 5.

Table 5 Using and non using mobile Internet by gender

Gender	Non- mobile Internet user	Mobile Internet user
Male	89.31	10.69
Female	88.37	11.63

Table 6 shows that mobile Internet seem to has a positively associated with respondent age. For example the percentage of mobile Internet user who aged from 15 to 19 is 8.47% compared to 12.47% and 13.58% of the respondent who aged from 20 to 29 and 30 to 39 years old. The proportion of mobile Internet user is, however, declining when the respondent becomes elderly people.

Table 6 Using and non using mobile Internet by age

Ages	Non- mobile Internet user	Mobile Internet user
15 - 19	91.53	8.47
20 - 29	87.53	12.47
30 - 39	86.42	13.58
40 - 49	90.10	9.90
50 - 59	97.83	2.17
60 - 69	91.89	8.11

Using mobile Internet seem positively associated with level of education with Table 6 showing that the respondents who has higher education are more likely to have Internet access via mobile phone.

Table 7 Using and non using mobile Internet by education

Education	Non- mobile Internet user	Mobile Internet user
Below undergrad	88.95	11.05
Undergrad	89.75	10.25
Above undergrad	84.21	15.79

A cross-tabulation between individual income and the mobile Internet usage seems to indicate mobile Internet is more prevalent for respondent who have high income. For example, about 9.02% of respondents with individual income below 5,000 THB use mobile Internet which is less than other income groups as shown in Table 7. Surprisingly, there are no respondents who earn monthly income from 20,001 to 25,000 use mobile Internet.

Table 8 Using and non using mobile Internet by income

Monthly income	Non- mobile Internet user	Mobile Internet user
< 5 000	90.98	9.02
5 001 - 10 000	87.10	12.90
10 001 - 15 000	88.76	11.24
15 001 - 20 000	85.71	14.29
20 001 - 25 000	100.00	0.00
> 25 000	89.47	10.53

Table 8 presents using mobile Internet by service and application factors and shows a positive association between the unavailability of fixed line facilities at home and using mobile Internet (23.05%) and also 6.91% of respondent who have fixed line at home are mobile Internet usage. Considering the applications, the respondents were asked about 9 applications that they frequently use via mobile Internet, for example e-mail, search, social network, online-video and radio. Three of them which the respondent use most are e-mail, search, and social network are only including in this study. Among these three applications, the search application is most population for mobile Internet users which is about 10.65% and followed by using e-mail and connecting to social network 9.80% and 9.49% respectively.

Table 9 Using and non using mobile Internet by service and applications

Technology and application factors	Non Mobile Internet user	Mobile Internet user
Has fixed telephony at home	93.09	6.91
Has no fixed telephony at home	76.95	23.05
E-mail	90.20	9.80
Search	89.35	10.65
Social network	90.51	9.49

Considering the mobile and mobile Internet user for each mobile operator, Table 9 indicate that 44.92% of the respondents are the customer of AIS and followed by DTAC(36.33%), TrueMove (17.47%) and Hutch (1.28%) respectively. Similarly, almost 50% of the mobile Internet users are AIS mobile subscribers and about 40% is DTAC subscriber while the rest is TrueMove and Hutch.

Table 10 Using and non using mobile Internet by mobile service operators

Operator	Mobile service	Mobile Internet
AIS	44.92	48.25
DTAC	36.33	39.47
TrueMove	17.47	9.65
Hutch	1.28	2.63

b. Method

To analyze the binary outcome variable (use or not use mobile Internet), this study employs the binomial probit model which based on discrete choice theory. Discrete choice theory is the study of behavior in situations where the individual must select from a finite set of choices. It assumes that an individual is likely to choose an alternative over others when the level of its utility to him is greater than the utility of other alternatives.

The probit regression analysis is a technique which allows for estimating the probability that an event occurs or not, by predicting a binary dependent outcome from a set of independent variables. In example of mobile Internet, the dependent variable is defined as using a mobile Internet or not in relation to technology, socio-economic factors and mobile operators. The level of utility that the *n*th respondent obtains from either use or not use mobile Internet service can be expressed as the following indirect utility function in term of z_{jn} (service and application factors and mobile operators, $j\epsilon\{use, not\ use\}$) and s_n (demographic characteristics).

$$U_{jn} = U(z_{jn}, s_n) \qquad j = \{use, not\ use\} \tag{1}$$

The indirect utility in (1) can be divided into an observed part (V_{jn}) and an unobserved part (e_{jn}).

$$U_{jn} = V_{jn} + e_{jn} \tag{2}$$

The probability of the *n*th respondent to use, as derived by making the level of utility from using greater than that from not using, can be expressed as follows.

$$Prob\ (use|j) = Prob(U_{use,n} > U_{not\ use,n}) \tag{3}$$

When the unobserved e_{jn} are independently, identically distributed according to the cumulative normal distribution, the functional relationship between revealed utility and the likelihood of using is binomial probit.

A binomial probit model is utilized to relate the probability of an individual respondent use the mobile Internet service to explanatory factors including technology factors, mobile operator and demographic variables. The model is of the form:

$$P_{jn} = F\left(x_{jn}^{'}\beta\right) \quad (4)$$

where P_{jn} is the probability that the *n* th respondent will use mobile Internet service j, x_{jn} is a vector of service and application attributes, mobile operator and socio-demographic characteristics. β is the parameter vector to be estimated and *F(.)* is the cumulative normal distribution function. In (4) the parameters relate changes in the explanatory variables to the direction of change in the using probability.

This model aims to reveal the important variables that impact the decisions of using mobile Internet. The value of the dependent variable was set to 1 when the respondent has decided to use the mobile Internet service, and 0 for the otherwise. Explanatory variables both service and application attributes, mobile operators and demographic factors included in the model are listed and described briefly in Table 10.

Table 11 Description of variables

Variable	Description	Mean	Std.Dev.
Dummy for mobile Internet use	= 0 if the respondent does not mobile Internet		
(Dependent variable)	= 1 if the respondent uses mobile Internet		
Service and application factors			
FIXED	= 1 if the respondent has fixed telephone at home; = 0 otherwise	0.7365	0.4407
EMAIL	= 1 if the respondent uses e-mail everyday ; = 0 otherwise	0.6797	0.4668
SEARCH	= 1 if the respondent uses search engine website everyday ; = 0 otherwise	0.8002	0.4000
SOCIAL	= 1 if the respondent uses social network website everyday ; = 0 otherwise	0.5779	0.4941
Socio-economic factors			
MALE	= 1 if the respondent is male; = 0 otherwise	0.4946	0.5002
LINCOME	= 1 if the respondent has monthly income below 5000 THB ;= 0 otherwise	0.4456	0.4973
MINCOME	= 1 if the respondent has monthly income between 5000 - 25000 THB ;= 0 otherwise	0.0813	0.2734
ALESS25	= 1 if the respondent is aged less than 25 years; = 0, otherwise	0.2498	0.4331
AMORE50	= 1 if the respondent is aged more than 50 years; = 0, otherwise	0.6572	0.4749
ED	= 1 if the respondent has bachelor degree or more ; = 0, otherwise	0.6278	0.4836
REGION	The base case (=1) is the respondent lives in Bangkok	2.9980	1.2021
CENTRAL	= 2 if the respondent lives in central region		
NORTH	= 3 if the respondent lives in north region		
NORTH-EAST	= 4 if the respondent lives in north-east region		
SOUTH	= 5 if the respondent lives in south region		
Mobile operator	The base case (=1) is the respondent is subscriber of AIS	1.7512	0.7835
DTAC	= 2 if the respondent is a subscriber of DTAC		
TRUEMOVE	= 3 if the respondent is a subscriber of TrueMove		
HUTCH	= 4 if the respondent is a subscriber of Hutch		

4. Findings and discussion

a. Findings

The regression result indicates that R^2 is 0.1118. It means that approximately 11.18% of the decision to use mobile Internet or not is explained by the model. The estimated results are reported in Table 11 by transforming to the marginal effects which can be explained that the changing in magnitude of dependent variable if the explanatory variable changes.

Table 12 The estimation results

Explanatory variables	Marginal effect	Std error	*t*-test	*p*-value
Service and application factors				
FIXED **	-0.1241	0.0194	-6.4100	0.0000
EMAIL**	-0.0532	0.0252	-2.1100	0.0350
SEARCH	0.0119	0.0269	0.4400	0.6570
SOCIAL	-0.0098	0.0221	-0.4500	0.6560
Socio-economic factors				
MALE	-0.0127	0.0191	-0.6700	0.5050
ALESS25**	-0.0543	0.0245	-2.2100	0.0270
AMORE50*	-0.0857	0.0458	-1.8700	0.0610
LINCOME	0.0088	0.0456	0.1900	0.8470
MINCOME	0.0075	0.0355	0.2100	0.8340
ED	-0.0092	0.0244	-0.3800	0.7060
CENTRAL**	-0.1416	0.0404	-3.5100	0.0000
NORTH**	-0.0868	0.0414	-2.1000	0.0360
NORTH-EAST	-0.0599	0.0417	-1.4400	0.1500
SOUTH**	-0.0975	0.0450	-2.1700	0.0300
Mobile operator				
DTAC	0.0002	0.0220	0.0100	0.9910
TRUEMOVE**	-0.0579	0.0231	-2.5000	0.0120
HUTCH	0.1024	0.1117	0.9200	0.3590
Number of observation	= 1013			
LR chi2(17)	= 87.20			
Prob > chi2	= 0,0000			
Log likelihood	= -312.7593			
Pseudo R^2	= 0.1224			

Note: *, ** represent significant at 10% and 5% level respectively

The results show that two of the service and application factors which are the availability of fixed telephony and the e-mail application have an inversely statistic significant to the mobile Internet usage. For example, the probability of using mobile Internet tends to increase 12.41% if fixed telephony (FIXED) is not available at home. The fixed line facility is an important factor for consumer to make his

decision to connect to the Internet as mentioned by Frieden (2005) and Lai and Brewer (2006). In addition, this study extends the finding of Ahn and Lee (1999) and Lai and Brewer (2006) that the under developed of fixed telephony infrastructure could stimulate the adoption of mobile Internet across the country.

Also, the respondent is less likely to use E-mail (EMAIL) application via mobile Internet. This result may suggest that the respondent prefer to access to their E-mail account via the fixed Internet connection. The result is contrast to the study by Funk (2005). This may due to the different social and culture factors between Thailand and Japan. The social network application also provides the same relation as E-mail while the searching application has a positive sign, but these two applications are not statistically significant.

For socio-economic factors, the effect of age is statistically significant to explain the probability of mobile Internet usage. If the respondent is less than 25 (ALESS25) or over than 50 (AMORE50), the probability of using mobile Internet tends to decrease 5.43% and 8.57% respectively. This would suggest that the respondents who are aged less than 25 and over 50 years old are less likely use mobile Internet compared to the respondent who are aged from 25 to 49 years old. In other words, the core segment for mobile Internet usage would be people in working age (25-50 years old) which is different from the study in Japanese market by Okazaki (2006).

The sign of coefficients of living region is also can explain the behavior of the respondent. The respondents who live in CENTRAL, NORTH, SOUTH is less likely to use mobile Internet compared to the respondent who live in Bangkok. This suggest that although the mobile infrastructure has a better coverage compared to fixed infrastructure but currently the respondent in these three region are not consider to access to Internet from their mobile phone as a main access.

The characteristic of mobile operator also influences the decision of respondent whether he will access the Internet via his mobile phone or not. The results indicate that if mobile subscriber of TrueMove is less likely to use mobile Internet compared to the mobile subscriber of AIS.

To sum up, the findings from this study provide a similar result to the previous studies. The estimated result show that the importance factors affecting the use of mobile Internet in Thailand is fixed telephony, e-mail application, mobile operator, age, area of living and mobile operator.

b. Discussion: Possibilities for bridging the digital divide

According to the results, there are several regulations and policies that the regulator and policy makers could consider to bridge the digital divide. The mobile Internet could be seen as another alternative for the closing the digital divide, in particular for the area that fixed telephony is unreachable. The current mobile Internet situation confirms that the three main conditions proposed by Gunasekarn and Harmantzis (2007) are applicable in Thailand. The wireless infrastructure including Wi-Fi hotspot fully covers populated areas. People, then, in any parts of the country could to access to mobile Internet as long as they have the mobile Internet device including Smartphone and the availability of wireless infrastructure. Considering speed and price of wireless Internet connection, the speed of wireless Internet connection is 2-3 times higher than dial-up Internet connection while the price of mobile Internet is about the same as dial-up. Thus, the wireless technology plays an important role to bridge the digital divide in Thailand for the short run. However, the current of 3G service offerings are very limit due to the legal problem about allocating 3G frequencies. It results in EDGE is currently the best option for nationwide coverage unfortunately. In the long run, the regulator and policy makers need to consider the investment in fixed, fixed wireless infrastructure and latest wireless technology e.g. WiMAX or LTE (Long Term Evolution) together with the issue of frequency allocation (spectrum assigning and re-farming) to eliminate the limitation of bandwidth capacity.

In addition, the regulator needs to seriously consider that type of competition does the country need. If the regulator would like to promote facility based competition, then the regulator should promote more fierce competition environment and the data roaming or infrastructure sharing regulation (including mobile virtual network operator) would not be proposed. However, the quality of service for mobile Internet service needs to be explicitly announced by the regulator to inform the mobile Internet service about their quality and ensure that consumer will gain the benefits.

Lastly, as mobile Internet grow in popularity, the content and application become the focus for several players in the value chain including mobile service providers. An application can be free because the developer is offering it at no cost to the consumer while charging for other things within the application e.g. advertising. The free application and content development may encourage consumer to have more experience with mobile Internet since cost and language might be the barrier for consumer to use the mobile Internet.

5. Conclusion

The transition of fixed to wireless technology in not limited only in the voice communication but it is now taking over in the data communication or the Internet. This phenomenon might indicate the good sign for bridging of digital divide by means of wireless technology. However, it is difficult to developed policies to accelerate the diffusion of mobile Internet without understanding the underlying factors which explain the mobile Internet adoption.

This study has examined the mobile Internet adoption in Thailand based on a nationwide survey of individual in 2010. The result of probit regression model show that fixed telephony, E-mail application, mobile operator, age of user, area of living and mobile operator are the important drivers for mobile Internet usage and adoption. Specifically, the results indicate that mobile Internet could be a potential means to bridge the digital divide for the areas which lack of fixed line facilities. The results also provide a better understanding of application attributes since useful and ease of use applications could encourage people to connect Internet via the mobile phone. In case of Thailand, pushing mail service is not popular for mobile Internet service while the application of search has a capability to increase the mobile Internet adoption.

Moreover, these results suggest that the role of NRA is needed in order to stimulate the growth of mobile Internet. In short run, frequency allocation will be an urgent task for the NRA in order to serve the consumer needs. In parallel, NRA need to think over how to encourage the investment in fixed and fixed wireless infrastructure to eliminate the limitation of bandwidth capacity in the long run. To make the analysis more dynamic, the future research could make a differentiation between traditional mobile user and mobile Internet user with a longer period of study. Then, the result will be useful for regulator and policy makers to analyze the mobile Internet adoption.

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